

### Crossing the Tyrrhenian Sea: spring migration of Marsh Harriers (*Circus aeruginosus*), sex classes and relation to wind conditions

The Marsh Harrier (*Circus aeruginosus*), unlike other raptors using mostly soaring flight over land during migration, tends to migrate on a broad front carrying out long powered flight over water (KERLINGER 1989). This species has high aspect ratio (long) wings decreasing energetic costs during powered flight (KERLINGER 1989). For this reason, concentrations of thousands of Marsh Harriers rarely occur (KERLINGER 1989, CLARKE 1995, ZALLES & BILDSTEIN 2000, CORSO 2001) although 51,000–74,000 pairs breed in Europe (mostly in Russia, Poland and Ukraine; FERGUSON-LEES et al. 2001) and winter in the Mediterranean basin and tropical Africa. As to Marsh Harriers migrating across the Channel of Sicily, birds ringed in Tunisia during spring were recovered NE in the Ukraine, Poland, Belarus and the Czech Republic (CRAMP & SIMMONS 1980). To date, during spring migration, the greatest concentration of Marsh Harriers was recorded at the Straits of Messina, between southern continental Italy and Sicily (Fig. 1; AGOSTINI & LOGOZZO 2000, ZALLES & BILDSTEIN 2000, CORSO 2001). There, between 1989 and 2000, on average 2215 birds were counted each year in the months April and May (ZALLES & BILDSTEIN 2000, CORSO 2001). Apparently, at that site, Marsh Harriers crossing the central Mediterranean between Tunisia and western Sicily (150–165 km over sea, AGOSTINI & LOGOZZO 1998, AGOSTINI 2001) converge with those passing Libya and southern Sicily (via Malta; approx. 400 km, BEAMAN & GALEA 1974, Fig. 1). However, during autumn migration, hundreds of Marsh Harriers undertake the crossing of the Tyrrhenian Sea flying about 500 km over water from central Italy to Africa, part of them via western Sicily (AGOSTINI et al. 2001). In this period notable concentrations of birds have been reported at the Circeo promontory (central Italy) and over the islands of

Capri and Marettimo (CORBI et al. 1999, JONZÉN & PETTERSSON 1999, AGOSTINI et al. 2001). Observations on the migratory flow of this species across the Tyrrhenian Sea during spring are lacking. The aim of this study was to investigate the spring migration of Marsh Harriers across the Tyrrhenian Sea both in relation to wind conditions and sex classes by observations over the island of Ustica (western Sicily).

### Study area and methods

Ustica is a small island (8.5 km<sup>2</sup>) about 60 km N of western Sicily, 270 km NE of the Cap Bon promontory (Tunisia), 140 km NE of the island of Marettimo and 230 km W of the Italian peninsula (Fig. 1). A total of 234 h of observations (9 h per day), with 10 X 40 binoculars, were made between 22 March and 16 April 2002, the peak period of the spring migration of this species on the Mediterranean basin (CRAMP & SIMMONS 1980, AGOSTINI & LOGOZZO 2000). The observation post was at the highest point (approx. 150 m) of the promontory dominating the NE coast of the island (its highest point, inland, reaching about 250 m). From this post it was possible to detect birds undertaking the crossing of the Tyrrhenian Sea. Each day was divided in three periods: morning (09.00–12.00 h), midday (12.00–15.00) and afternoon (15.00–18.00; solar time). Hourly meteorological data from Ustica were provided by the Italian Air Force. It was possible to determine the age and sex of 294 birds by observation of their plumage (FORSMAN 1999). The total of males, females and juveniles was derived by multiplying their proportions in the sample of identified individuals, following the method used by KJELLÉN (1992) at Falsterbo (Sweden). In particular, to exclude a bias due to the better identification of adult males, the proportion of females and juveniles was estimated dividing unidentified individuals of the group female/juvenile between the two age groups according to their proportion among the identified birds (see also AGOSTINI & LOGOZZO 2000, AGOSTINI 2001, AGOSTINI et al. 2001).

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Fig. 1: The study area.

Abb. 1: Die Beobachtungsregion.

### Results

A total of 648 Marsh Harriers reached the north-east coast of the island from SW and S and continued the crossing of the Tyrrhenian Sea towards NE. It was possible to estimate 586 (90.4%) adults and 62 (9.6%) juveniles and, among adults, males outnumbered females (348 vs 238;  $\chi^2 = 20.3$ , d.f. = 1,  $P < 0.01$ ). The migratory flow varied significantly throughout the day ( $\chi^2 = 23.7$ , d.f. = 2,  $P < 0.01$ ), with the lowest proportion of individuals recorded during the morning (Fig. 2). The strength of the wind had a significant effect on the migratory flow.

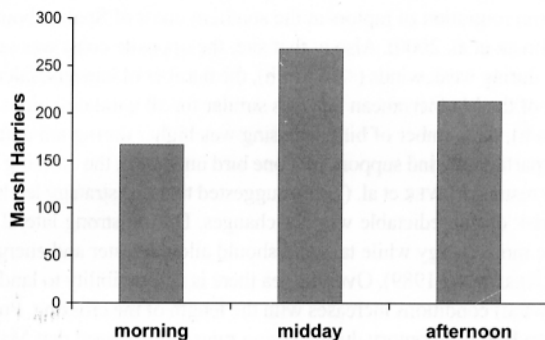


Fig. 2: The migratory flow of the Marsh Harrier through the day over Ustica.

Abb. 2: Rohrweihenflug über Ustica, Aufgliederung nach Tageszeiten (vormittags, mittags, nachmittags).

Although the frequency of strong winds ( $> 15$  km/h) was higher during each wind component (headwind [mean direction =  $71.9^\circ \pm 3.2^\circ$  se]:  $\chi^2 = 9.14$ , d.f. = 1,  $P < 0.01$ ; tailwind [mean direction =  $237.5^\circ \pm 4.8^\circ$  se]:  $\chi^2 = 4.7$ , d.f. = 1,  $P < 0.05$ ; lateral wind [mean directions =  $139.2^\circ \pm 3.7^\circ$  se,  $319.4^\circ \pm 2.8^\circ$  se]:  $\chi^2 = 4.46$ , d.f. = 1,  $P < 0.05$ ; Fig. 3), Marsh Harriers were seen mostly during weak winds (wind speed below 15 km/h; headwind:  $\chi^2 = 17.52$ , d.f. = 1,  $P < 0.01$ ; tailwind:  $\chi^2 = 22.82$ , d.f. = 1,

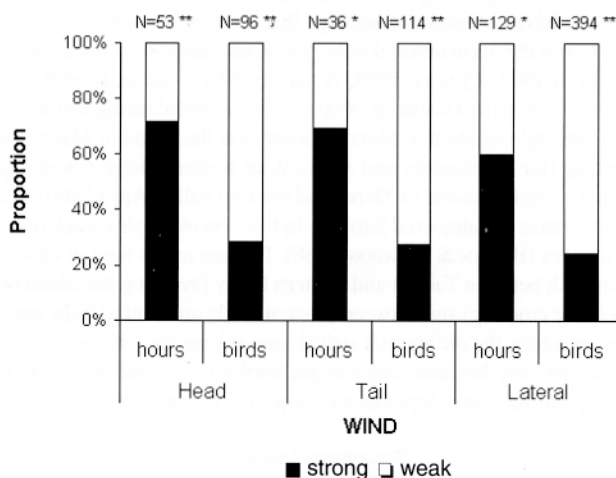


Fig. 3: Proportion of hours and proportion of birds recorded with weak ( $< 15$  km/h) and strong ( $> 15$  km/h) head, tail and lateral winds (\* =  $< 0.05$ ; \*\* =  $P < 0.01$ ).

Abb.3: Häufigkeit von schwachen ( $< 15$  km/h) bzw. starken ( $> 15$  km/h) Gegen-, Rücken- und Seitenwinden jeweils mit Bezug zur Anzahl beobachteter Rohrweihen.

$P < 0.01$ ; lateral wind:  $\chi^2 = 104.6$ , d.f. = 1,  $P < 0.01$ ; Fig. 3). Moreover, regarding winds with tail and head components (frequency 36 vs 53 hrs,  $\chi^2 = 2.87$ , df = 1,  $P > 0.05$ ), the difference between the total numbers of birds observed under these conditions did not differ significantly (114 vs 96;  $\chi^2 = 1.38$ , df = 1,  $P > 0.05$ ). A total of 44 Marsh Harriers was recorded during absent wind (frequency 16 h).

### Discussion

Our results partially agree with those of a recent study made simultaneously by radar and visual observation during the autumn migration of raptors at the southern coast of Spain, about 100 km NE of the Straits of Gibraltar (MEYER et al. 2000). Also at that site, the opposite coast was out of sight (distance about 150 km). There, during weak winds (< 15 km/h), the number of harriers, falcons and ospreys undertaking the crossing of the Mediterranean Sea was similar for all wind directions. In contrast, during strong winds (> 15 km/h), the number of birds crossing was higher during tail and lateral winds if the latter provided at least partial tailwind support. Not one bird undertook the crossing during strong headwind. To explain these results, MEYER et al. (2000) suggested that this strategy leads to shorter crossing times and lowers the risk of unpredictable weather changes. During strong lateral and headwinds the crossing would require more energy while tailwind should allow a faster and energetically less expensive flight over water (KERLINGER 1989). Over the sea there is no possibility to land and the probability of changing weather (wind) conditions increases with the length of the crossing. Previous visual observations made at the Cap Bon promontory during spring migration showed that Marsh Harriers tend to cross the Channel of Sicily both during weak and strong lateral winds such as Black Kites (*Milvus migrans*) and Montagu's Harriers (*Circus pygargus*; AGOSTINI & DUCHI 1994). However, once reached western Sicily after the long sea crossing (approx. 150 km), tired birds have to decide whether to minimize energy (for instance using mostly soaring-gliding flight over land or going hunting along the way), or to fly again NE about 300 km across the Tyrrhenian Sea migrating also during the night minimizing the time of migration. In fact, because over Ustica Marsh Harriers are observed mostly during midday and afternoon, probably at least some of them cross the Tyrrhenian Sea immediately after the Channel of Sicily flying about 500 km over water in one day also during the night. Our results suggest that, avoiding the crossing of the larger body of water during strong wind independently from its direction, Marsh Harriers seem to have a conservative strategy flying slower but safely.

In the Marsh Harrier the occurrence of polygyny would suggest an imbalance towards females among adults (KJELLÉN 1992, CLARKE 1995, AGOSTINI 2001), and in several populations of this species females outnumber males (SIMMONS 2000). A similar unbalancing was also recorded in a recent research on the spring migration of Marsh Harrier over the island of Marettimo, located about 130 km NE of the Cap Bon promontory and 35 km W of western Sicily, where a total of 577 individuals were counted between the end of March and the first half of April 2000 (AGOSTINI 2001). In contrast, in our study males outnumbered females. In this species, males reach breeding areas some days earlier than females (BROWN & AMADON 1968). Perhaps males tend to choose, more than females, direct routes both between Tunisia and western Sicily (avoiding the island of Marettimo and saving about 10% of the crossing) and between western Sicily and central Italy, minimizing the time of migration. Thus, as a rule, the differential arrival time at breeding sites among sex classes in this species, could occur not only because males begin northward migration earlier but also because they tend to fly along shorter routes between wintering and breeding areas.

### Zusammenfassung

Überquerung des Tyrrhenischen Meeres: Frühjahrszug von Rohrweihen (*Circus aeruginosus*), Geschlechterverhältnis und Einfluss der Windverhältnisse.

Auf der Insel Ustica (ca. 60 km nördlich von Westsizilien) wurde zwischen 22. März und 16. April 2002 jeweils 9 Std./Tag der Frühjahrszug von Rohrweihen über das Tyrrhenische Meer beobachtet. In dieser Zeit konnten

insgesamt 648 Vögel erfasst werden, die jeweils aus Richtung S und SW eintrafen und die Überquerung des Meeres in Richtung NE fortsetzten. Nur ein kleiner Teil der Vögel wurde morgens gesichtet, die meisten erschienen nachmittags 2 bis 3 Std. vor Sonnenuntergang. Dies zeigt, dass Rohrweihen das Meer auch nachts überqueren können. Bei schwachen Winden (< 15 km/h) herrschten ideale Zugbedingungen. Trotz des polygynen Verhaltens der Rohrweihe waren nicht die ♀, sondern ♂ in der Überzahl. Möglicherweise ist die Neigung, auf einer mehr direkten Route in die Brutgebiete zu ziehen, um diese möglichst früh zu erreichen, bei ♂ stärker als bei ♀ ausgeprägt.

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